AMENDMENTS TO THE CLAIMS

This listing of the claims replaces all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS

1. [Currently Amended] A method for discriminating noise from signal in a noise-contaminated signal, comprising:

decomposing a frame of the noise-contaminated signal received in a predefined time period into decorrelated signal components; and

for each component:

recursively updating respective parameters characterizing a Gaussian noise distribution and a signal distribution of ~~each of~~ the ~~respective~~ components as a function of time; ~~and~~

using the respective parameters to evaluate a composite Gaussian and signal distribution function to provide ~~a measure~~an estimate of noise and signal contributions to the component; and

attenuating the component in proportion to the estimated noise contribution to the component.

2. [Original] The method as claimed in claim 1 wherein the signal is a noise-contaminated voice signal and recursively updating comprises recursively updating respective parameters characterizing the Gaussian noise distribution and a Laplacian voice distribution.

3. [Original] The method as claimed in claim 1 wherein decomposing the frame comprises applying a matrix transform to the frame, which consists of a predefined number of samples.

4. [Original] The method as claimed in claim 3 wherein applying the matrix transform comprises mapping the frame of samples from a time domain to a frequency domain.

5. [Original] The method as claimed in claim 4 wherein mapping the frame comprises applying a discrete cosine transform to the frame of samples.

6. [Original] The method as claimed in claim 3 wherein applying the matrix transform comprises mapping the frame of samples to basis functions, which are the components.

7. [Original] The method as claimed in claim 6 wherein mapping the frame comprises decomposing the frame into at least one of wavelets and sinusoidal functions.

8. [Original] The method as claimed in claim 6 further comprising recomputing the basis functions to adaptively optimize decomposition.

9. [Original] The method as claimed in claim 8 wherein applying the matrix transform comprises applying an adaptive Karhunen-Loeve transform.

10. [Currently Amended] The method as claimed in claim 2 wherein recursively updating <u>respective parameters</u> comprises using a value computed ~~when the components of~~ <u>during processing of</u> a previous frame ~~were processed~~ to ~~determine~~ <u>select</u> which of the parameters characterizing ~~the respective~~ <u>each</u> distribution to update.

11. [Currently Amended] The method as claimed in claim 10 wherein the ~~previously computed value~~ <u>value computed during processing of a previous frame</u> is an *a priori* probability ~~of~~ <u>that</u> the frame ~~constituting~~ <u>constitutes</u> noise, and using the *a priori* probability to ~~determine~~ <u>select</u> which of the parameters to update comprises:

selecting a measure of variance that characterizes the Gaussian noise distribution if the *a priori* probability is below a predetermined threshold; and

otherwise selecting a measure of variance factor that characterizes the Laplacian distribution.

12. [Original] The method as claimed in claim 11 wherein the *a priori* probability is defined by evaluating a hidden state of a hidden Markov model.

13. [Original] The method as claimed in claim 12 wherein recursively updating a parameter further comprises incrementally changing the parameter in accordance with a difference between an expected value of the component given the past value of the parameter, and the value of the component received.

14. [Currently Amended] The method as claimed in claim 13 wherein incrementally changing <u>the parameter</u> comprises applying a first order smoothing filter to the components.

15. [Original] The method as claimed in claim 14 wherein a time constant of the first order smoothing filter is chosen as a time during which the distribution is stationary.

16. [Original] The method as claimed in claim 11 wherein using the respective parameters to determine which of the parameters to update comprises computing a measure of fit of the components to a composite Gaussian and Laplacian distribution.

17. [Original] The method as claimed in claim 16 wherein using the respective parameters to determine which of the parameters to update further comprises:

computing a measure of fit of each of the received components to a respective Gaussian noise distribution defined using the respective parameters; and

comparing a mean of the measures of fit to the respective Gaussian noise distributions with a mean of the measures of fit to the composite Gaussian and Laplacian distributions, to compute a likelihood that the components of the frame constitute noise or noise-contaminated voice signal.

18. [Original] The method as claimed in claim 17 wherein computing a measure of fit to either of the distributions comprises evaluating the distribution at the value of the component received.

19. [Original] The method as claimed in claim 18 wherein comparing a mean of the measures of fit comprises dividing a product of the measures of fit of the components to the composite Gaussian and Laplacian distribution by a product of the measures of fit of the components to the noise distribution.

20. [Original] The method as claimed in claim 19 wherein using the respective parameters to evaluate further comprises using the likelihood and the *a priori* probability to compute an *a posteriori* probability that the frame is noise-contaminated voice signal.

21. [Original] The method as claimed in claim 20 wherein using the respective parameters to evaluate further comprises using the *a posteriori* probability and a predefined fixed set of transition probabilities to compute an *a priori* probability that a next frame constitutes noise-contaminated voice signal.

22. [Currently Amended] The method as claimed in claim 1 wherein using the parameters to evaluate a composite Gaussian and signal distribution function comprises computing at least an approximation to an expected value of the composite Gaussian and signal distribution using ~~the~~ a respective value of ~~the~~ each component, and the parameters, to obtain a corresponding signal-enhanced component, if it is determined that the frame is signal active.

23. [Currently Amended] The method as claimed in claim 22 wherein computing at least an approximation comprises computing a piece-wise ~~linear~~ function approximation of the expected value as a function of the parameters and the component.

24. [Currently Amended] Apparatus for speech enhancement, comprising:

a signal transformer for decomposing a frame of samples of a noise-contaminated speech signal received in a predetermined time interval into decorrelated signal components;

a component distribution parameter reviser for recursively updating respective parameters characterizing a Gaussian noise distribution and a Laplacian

speech distribution of each of the respective components as a function of time;

a voice activity detector for determining whether the noise-contaminated speech signal is voice active in the time interval; and

a clean speech estimator for using composite Gaussian and Laplacian distributions defined with the parameters, and ~~the~~ a respective values of ~~the~~ each components to obtain a vector of speech-enhanced components, if it is determined by the voice activity detector that the frame is voice active; and

an inverse signal transform for re-composing the frame of samples.

25. [Original] The apparatus as claimed in claim 24 wherein the clean speech estimator computes an expected value of each of the composite Gaussian and Laplacian distributions to independently derive a speech-enhanced component corresponding to each of the components.

26. [Original] The apparatus as claimed in claim 25 wherein the signal transform comprises means for decomposing the frame of samples using a discrete cosine transform.